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STATE WATER SURVEY DIVISION
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ANNUAL
1971
REPORT

JUN 27 1972

AFTER THE
1871
CHICAGO FIRE

A CENTURY OF RECOVERY AND GROWTH

CHICAGO CITY COUNCIL 1971

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(a) Resigned December 1, 1971

1971 ANNUAL REPORT
DEPARTMENT OF WATER AND SEWERS
CITY OF CHICAGO



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Respectfully submitted,

James W. Spill
Commissioner

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HIGHLIGHTS

□ An average of 1 billion, 28 million gallons of water per day, totaling over 375 billion gallons for the entire year, was pumped through the Chicago water distribution system during 1971.

□ More than 18 miles of new water mains and 26 miles of new sewers were constructed in 1971. Also, 850 catch basins and 897 manholes were added to the sewerage system.

□ Collections for Water Fund Revenue items amounted to \$71,004,306 during the year covered by this report and \$10,440,816 was invested in Chicago Water System capital improvements. Programmed expenditures for capital improvements over the 1971 to 1975 period total approximately \$155,828,000.

□ New pumpage records were set on June 29, 1971, when more than 1 billion, 762 million gallons of water were pumped for the day, with the highest hourly rate of 2 billion, 305 million gallons a day at 4:00 P.M.

□ In 1971, the City Council approved the 65 new street grades as set and submitted by the Bureau of Sewers. Also, 185 standard bench monuments and ordinary benches were established.

□ The Water Purification Laboratories conducted 378,079 tests of the water during the year.

□ The program to convert the boiler equipment in the five steam-operated pumping stations from coal to natural gas fuel (with oil as a secondary or stand-by fuel) to eliminate sulphur dioxide and particulate emissions from the stations' smokestacks has progressed to the stage where an early completion can be expected.

□ During the year, all glass piping which carries chlorine under vacuum from chlorinator units to points of application were replaced in the Central Water Filtration Plant with reinforced plastic. This provided a more reliable and safer system for disinfecting the water being treated.

□ The sediment and wash water disposal systems at the Filtration Plants are in the process of revision.

□ More than ten thousand feet of 24-inch and 36-inch cast iron feeder mains were cleaned

and cement lined during 1971. This restored the interior of the mains and their capacity to their original state, regardless of their age.

□ The value and effectiveness of the Safety Rules booklet that was issued to employees in 1971 is reflected in the year's improved safety record which attests to the decrease in human suffering and costly time lost because of accidents.

□ More than 17,450 persons toured the Central Water Filtration Plant during 1971. Most visitors were students of all grade levels, including grammar school pupils, but many were also engineers, scientists and technicians. Numerous dignitaries and officials from 22 foreign countries, as well, participated in the tours.

□ During October, when Chicago observed the centennial of the Great Chicago Fire of 1871, the Department of Water and Sewers participated by displaying in the lobby of the City Hall illuminated panels depicting the Old Chicago Water Tower as it appeared shortly before and immediately after the fire. The present methods of purification and distribution of water were also illustrated and explained.

□ During the year of the 100th anniversary of the Great Chicago Fire, the Old Water Tower and the Old Chicago Avenue Pumping Station, both survivors of that fire, were proclaimed by the City Council to be Chicago Landmarks — symbols of the City's history, signifying the staunch faith of early citizens in her future and her indestructible "I WILL" spirit. The Pumping Station is still in full operation after more than a century of reliable service to the public.



Mayor Richard J. Daley reviews highlights of Chicago's development with Commissioner James W. Jardine.



A CENTURY OF RECOVERY AND GROWTH

2

On the morning of Tuesday, October 10, 1871, a group of weary Chicagoans stood in line, somberly and patiently, awaiting their turn to enter the Chicago Water Tower. When finally inside, they climbed the iron staircase circling up to the observation room in the cupola and gazed anxiously across the upper parapet through the narrow slit windows.

What they saw was not pleasant. A young city had just been devastated by an incredibly horrible fire. Their urgent impulse to survey such ruin was not incited by morbid fascination. They, with their families, had been driven from their homes and hoped to learn, from the top of the Tower, the fate of the property from which they had fled very early the morning before. The Water Tower served as a vantage point and guidepost to the homeless.

The air was sullied with the stench of wet ashes; the ground was saturated with the heavy rainfall after an unusually severe drought which is believed to have precipitated the holocaust. Even though the displaced householders were provided with all the grounds for gloom and despair, other feelings and thoughts sparked in their hearts and minds, especially determination, with the indomitable will not only to survive but to build an even greater City of Chicago.

Now the Water Tower is considered more than a beautifully masked iron standpipe; it is regarded as a memorial to the victims of the Great Fire. The Water Tower and the Chicago Avenue Pumping Station are the only structures on Chicago's Near Northside that survived the Fire and are still in existence. What was known as the Mahlon Ogden residence was also fortunate in withstanding the ferocious flames but it has

long since been replaced by the Newberry Library. The Pumping Station, which is located directly across Michigan Avenue east of the Water Tower, was severely but not hopelessly damaged. Although its roof was entirely destroyed, the Station was back in service after only eight days, supplying the water that was so vitally needed. At that time, it was the Chicago Water System's only Pumping Station.

In the 119 years since the municipally owned water system was put into operation and the 100 years since the Great Fire, the City of Chicago grew in population to second largest city in the United States. The number of persons provided with Chicago water increased from 65,000 to 4½ million, and now includes the residents of 72 suburban communities.

The valiant Water Tower could hardly be reproached for being apprehensive about its survival during the years after the Fire. In the post-fire period, many new structures were being put up rapidly and much higher than their predecessors had been. The passing of each decade was reflected by the changes in architectural forms; so there was a danger that the Tudor and Gothic tower elements—remindful of an historic castle—which were incorporated in the original design would soon clash with the 20th Century simplicity that was replacing the ornate Victorian styles.

The history of the beloved reminder of Chicago's past includes other confrontations with distress besides the Fire of 1871. During the 1917-1918 period, several structures along North Michigan were razed, in accordance with plans to widen the boulevard and to make certain that it is perfectly straight. The Water Tower



Fire-devastated structures surround stalwart Chicago Water Tower after the 1871 conflagration.

was included among those edifices destined for destruction but, because many civic organizations (especially the Chicago Historical Society) objected so intensely, it was decided that the Tower instead be moved from its original location, off the intended route. It was later concluded, however, that such a procedure would probably cause the Water Tower to crumble, so that the initial plan of demolition would be the most practical and, therefore, the one to be followed.

Apparently, the planners were not fully aware of the Water Tower's place in the hearts of the Chicagoans who emphatically indicated their firm intention to prevent the wrecking of the symbol of their City's invincible "I WILL" spirit. Finally it was conceded that the wishes of the public regarding their most cherished Landmark merited priority over the straightness of Michigan Avenue (which was known as Pine Street before 1917). This accounts for the slight turn as it now bypasses the Tower.

Other attempts to have the Tower demolished also failed, such as when in 1948 a proposal to use the Tower grounds exclusively for a community art center was turned down.

Even the stalwart Water Tower did not escape the Great Fire's fury completely without scars. Great energy was expended in the rehabilitation and repair of the stonework. It wasn't until 1912 that the appearance of its exterior was restored and at that time, a new stairway was installed. The obsolete standpipe had been removed the year before and in 1914 a new steel cupola with a copper roof was added.

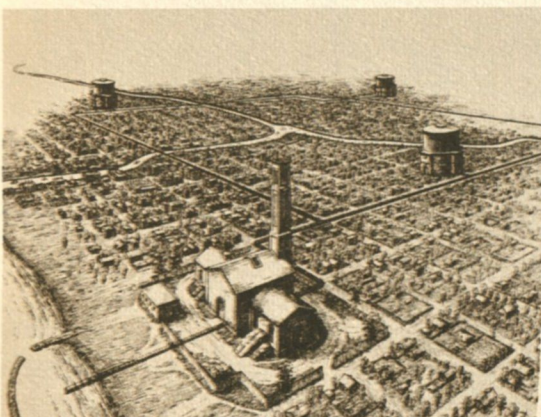
Extensive long-range measures are being taken

to guard against the deterioration of the Joliet limestone of which both the Water Tower and the Chicago Avenue Pumping Station are constructed. Since this type of stone is no longer available, it is of vital importance that an adequate maintenance program be followed to protect those landmarks. Unfortunately, Joliet limestone is very susceptible to deterioration when subjected to adverse atmospheric conditions.

Further, tests are being conducted with chemical formulas that hopefully will be helpful in preserving the limestone facings of the Tower and the Pumping Station.

During October of this year while the City observed the 100th anniversary of the Great Chicago Fire, the Department of Water and Sewers participated by displaying in the lobby of the City Hall illuminated panels depicting the Old Water Tower as it appeared shortly before and immediately after the Fire. The progress and growth of the Chicago Water System were also featured. In addition, its present methods of purification and distribution of water were illustrated and explained.

In 1971 both the Water Tower and the Chicago Avenue Pumping Station, which is still in full operation after more than a century of reliable service to the public, were proclaimed by the City Council to be Chicago Landmarks—signifying the great faith of early citizens in the future of a courageous young municipality. It was during May of 1969, the year of the Water Tower Centennial Anniversary, that it was selected by the American Water Works Association to be the first American Water Landmark in the Nation.



Chicago's original water supply system of 119 years ago and today's Central Water Filtration Plant—the world's largest.



PURIFICATION

Major projects upon which the attention of the Water Purification Division of the Bureau of Water was focused during 1971 included the revision of systems for the disposal of sediment from water filters and also the water that has been used to backwash the filters. Engineering plans were formulated for the construction of facilities which, when completed, will provide for the discharge of sediment into a sewer line connected to an interceptor of the Metropolitan Sanitary District of Greater Chicago; it will not be returned into Lake Michigan. The filter wash water will be recirculated to the intake channels to be mixed with raw water to be processed.

During the year, misgivings caused by the presence of certain trace metals in the lake motivated the Division's regular use of the Flameless Atomic Absorption method in the examination of raw and treated water. Trace elements detected were in extremely low ranges and well below the standards established by the United States Public Health Service. Tests for radioactivity also indicated that existing levels of radiation fell far below limits determined acceptable by the Atomic Energy Commission.

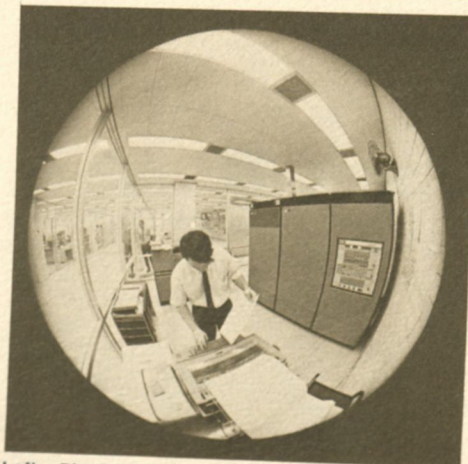
As in previous years, the Department of Water and Sewers participated in the United States Environmental Protection Agency Four-State conferences on Pollution of Lake Michigan. Staff members provided valuable technical data gleaned from Lake surveys and laboratory analyses. As the emphasis shifted from Federal to State activity during the period covered by this Report, representatives of this Department took active part in hearings conducted by the Illinois Pollution Control Board to revise the language of the water quality standards.

During 1971, more than 249 billion gallons of raw water were pumped from Lake Michigan by the Central Water Filtration Plant. The year's peak hour of pumpage occurred on June 28 at 4:00 P.M. when water was pumped at the hourly rate of 1,648 million gallons per day. During the year, 235 billion gallons of the total amount pumped were treated and supplied to consumers; the remainder was used in the operation of the plant.

The South Water Filtration Plant pumped 145 billion gallons of raw water from the Lake as its year's supply. Its peak hourly rate at 5:00 P.M. on June 28 was 835 million gallons per day. Of the year's total amount of raw water provided by the Lake, 141 billion gallons were treated at the South Plant and distributed to consumers. The rest was used by the plant.

The transformation of Lake Michigan's raw water into the sparkling, pure finished water at the two largest filtration plants in the world is by no means a simple process. A variety of chemicals are added to produce a high quality potable water. The purpose of some of these chemical additives is to sterilize the water of disease-carrying organisms; some to promote sound, healthy teeth for children and enhance the water's taste and odor; others to reduce water pipe corrosion and to aid in the water treatment and filtration process. A tabulation of the quantities of chemicals used in the two filtration plants in 1971 is included in the Major Statistics tables on the last pages of this Report.

In 1971, a consulting contract was negotiated with the Illinois State Water Survey and the University of Illinois for the construction of a work-



Left—Plant operation is monitored in Central Water Filtration Plant's data analysis room.
Right—New South Water Filtration Plant control laboratory conducts chemical tests continuously.

ing model of a mixing and settling basin. When the model is completed, the consulting staff, in cooperation with this Departmental staff, will conduct studies of the flow characteristics in the prototype to determine and develop methods that will provide for better settlement in the basins at the Central Water Filtration Plant. It is hoped that this experiment will find ways to improve the quality of the water flowing to the filters and increase plant operating effectiveness.

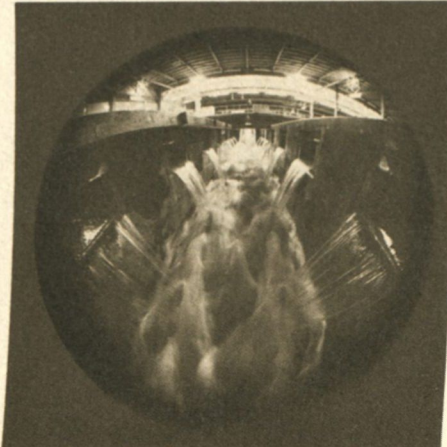
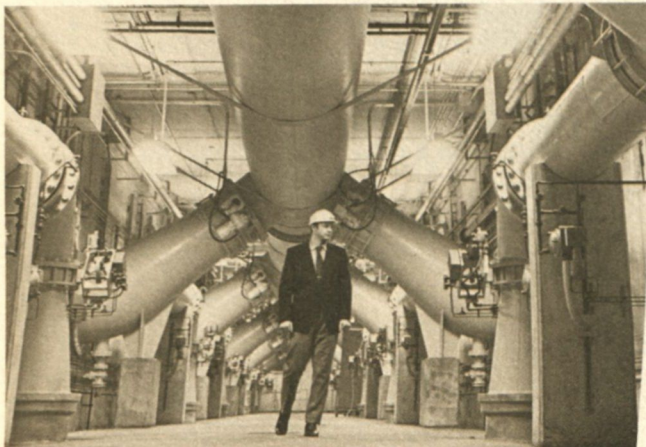
During the year, plans were drafted at the Central Plant to improve plant hydraulics by permitting filtered water to flow directly from the clearwells to the filtered water reservoir. Also, all critical glass pipe chlorine lines at this plant were replaced with reinforced plastic to afford a more dependable water disinfecting system. At the South Plant, projects were initiated to cap rapid sand filters with anthracite coal as a replacement for the coarsest gravel level in the filters. Tests indicated that the use of anthracite lengthens filter runs and reduces costs. Both filtration plants are supplied with raw water by crib intakes as well as shore intakes and they can shift with maximum flexibility from crib to shore and shore to crib, depending on which source is currently furnishing the better quality water. As an added advantage of this dual source of supply at each plant, it is possible to apply activated carbon and chlorine to raw water about 1,200 feet before it undergoes other processing, thus permitting special treatment of plankton odors and phenolic material.

During the year, the Division continued the work of flushing and sterilizing with chlorine newly installed or repaired water mains, tunnels

and shafts for the 24 hours prior to their being put into service. The Water Quality Surveillance Section then tested water samples from various locations to insure that such recently installed or repaired facilities were effectively sterilized. The Division also surveyed channel dredging and dumping operations; reviewed plans and recommended improvements for suburban water systems; and made statistical studies of field data. In 1971, the Water Purification Laboratory Section made 378,079 tests of water collected by the Water Quality Surveillance Section from Lake Michigan, the Calumet River System, intake cribs, pumping stations and the distribution system.

The Chicago Water System's captivation of world-wide interest was evidenced by the growing number of foreign officials, professionals, technicians and student engineers coming from distant lands to join the thousands of Chicagoans and visitors from other parts of the United States on tours conducted through the Central Water Filtration Plant. Participants of such tours during 1971 totaled 17,456; most were students at all levels of education, including many grammar school pupils.

The Water Purification Division is also concerned with the future. Comprehensive planning for facilities which will be needed in years to come is essential to the insurance of adequate service to the public. The Department's Capital Improvement Program for the five-year period from 1971 to 1975 provides for a planned expenditure of \$24,685,000 toward the improvement of the Water Filtration Plants and \$35,175,000 for additions and modifications of water tunnels and reservoirs.



Left—Filter pipe galleries at the Central Water Filtration Plant. Right—Plant's filter beds undergo backwash procedure.



PUMPING

Throughout 1971, the Chicago Water System's pumping stations furnished a supply of more than 375 billion gallons of water to all sections of the City and to 72 suburban communities in the dependable manner upon which the public relies. These eleven stations, of which five are powered by steam, six by electricity, are equipped with 53 pumps and have a total pumping capacity of 2,995 million gallons a day.

On June 29th of this year, new pumpage records were established when one billion, 763 million gallons of water were pumped for the day. Also, on that date, at 4:00 P.M. a new "high" for hourly pumpage rates of two billion, 305 million gallons per day was attained. With a reserve pumping capacity of nearly 700 million gallons of water even under peak load conditions, the stations were able to alternate or change pumping equipment whenever necessary without interfering with service.

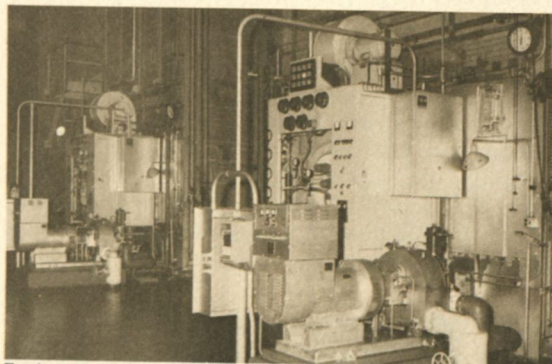
In compliance with the air pollution control provisions of the Municipal Code of Chicago, the

steam pumping station fuel conversion program moved ahead during the year and the total conversion is expected to be accomplished in 1972. It is important that sulfur dioxide and particulate matter be eliminated from the stack emissions of the steam-powered pumping stations and that the stations also obtain the greater flexibility of operation—a by-product of the conversion.

Chicago has long demonstrated its determination to preserve and protect the famous Water Tower landmark that has captured the hearts of its citizens. In 1971, a new electric service and heating system was installed to provide for more attractive floodlighting and to maintain the proper temperature to keep the Tower's interior dry.

Pumping station improvements made during 1971 include:

A new emergency dewatering pump at the 68th Street Pumping Station. This pump is designed to cope with heavier-than-routine drainage that could not be effectively handled by the station's sump pumps. The new dewatering pump pro-



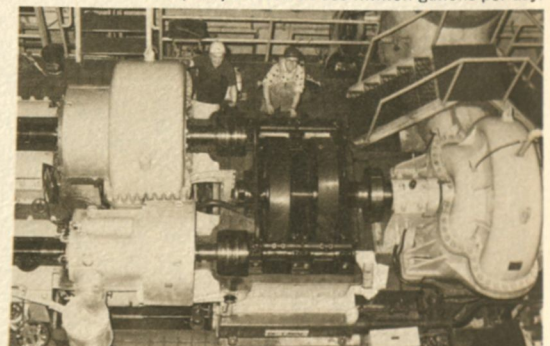
Fuel conversion units at Western Ave. All boilers have been converted to gas at this pumping station.



Control console for one of the Mayfair Pumping Station boiler conversion units is serviced.



Maintenance work at Central Park—this station has five pumps rated at 360 million gallons per day.



Pump maintenance at Western Ave.—this station has four pumps rated at 320 million gallons per day.

vides additional protection to equipment—especially the 1,500 horsepower electric water pump motors;

New electric valve operators on the Western Avenue Reservoir drain and fill valves. The hydraulic valve operators previously used were prone to creep and cause flow variation. The replacement resulted in a more reliable control of flow;

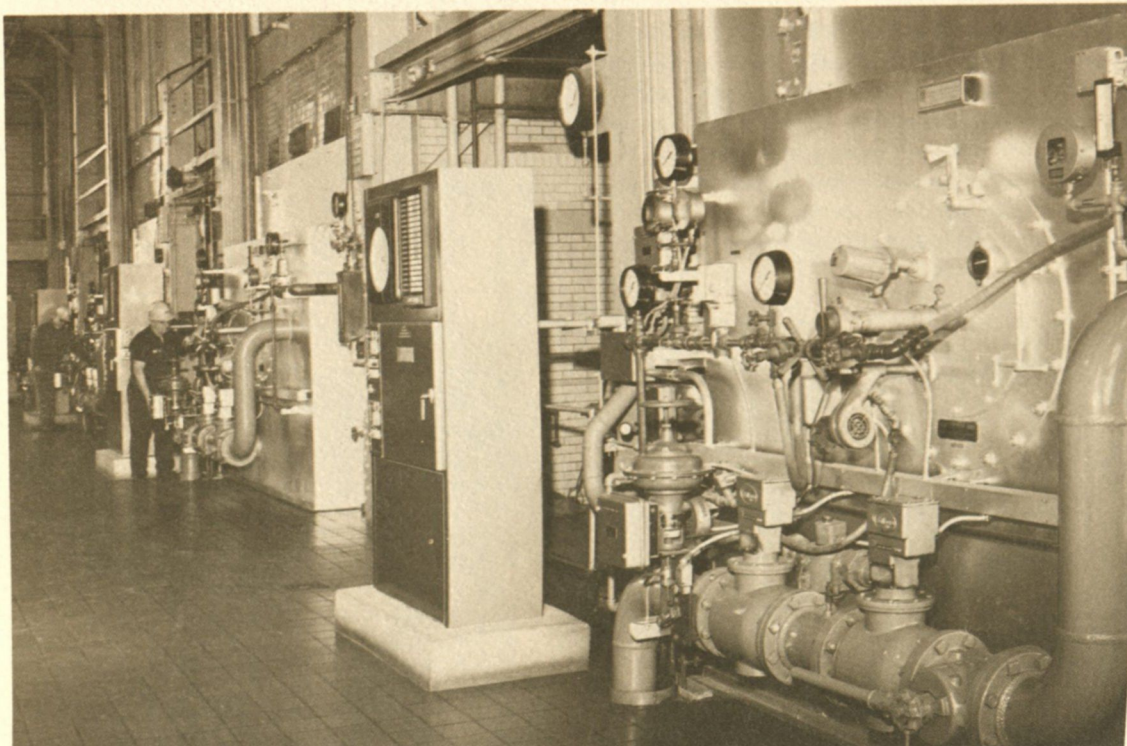
An exhaust fan in the gas meter room of the Western Avenue Pumping Station. This fan provides an adequate number of air changes—which is vitally important if a gas leak occurs that could otherwise build up into an explosive mixture; and

Two new electric motor drives to replace water turbine drives on the condensate pumps for two of the steam driven water pumps at the Mayfair Pumping Station. With these electric motors, the plant operates more efficiently.

Also, the Roseland Pumping Station's high pressure service area was reduced to lessen the

station's boiler load, to curtail leakage in the section that was removed from the high pressure area, and to increase the flexibility of the distribution system.

The Pumping Station Operation Division is responsible also for the operation and maintenance of the active and stand-by water intake cribs located two to two and one half miles offshore. During 1971, two 15 kilowatt diesel generators were installed on the Carter Harrison Crib, which along with the William Dever Crib, serves as a source of supply for the Central Water Filtration Plant. The generators will be available to provide a temporary power supply to the dual crib complex as well as the stand-by Wilson Avenue Crib until the cable connection is restored to furnish a permanent power supply. The cable was severed by unknown causes in 1970. The feasibility of utilizing a cable originally installed on the lake bottom to supply power to a United States Coast Guard lighthouse via the Harrison Crib is under consideration.



All four Springfield Pumping Station boilers are now converted to use natural gas fuel.



DISTRIBUTION

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In 1852, when the responsibility of providing water to residents of Chicago was acquired by that young City, its water distribution system consisted of about 30 miles of water pipes (most of which were hollow logs with a bore of from two to six inches in diameter) and 123 fire hydrants. During the next nineteen years, Chicago grew rapidly in both population and land area. By the end of 1871, the year during which the dynamic, expanding municipality was ravaged by the ferocious Chicago Fire, its facilities for the distribution of water had been improved to include nearly 1,670 fire hydrants and 290 miles of the cast iron water pipes which replaced the original wooden mains. Rather than causing a halt in Chicago's progression, the Fire served as a stimulus to the City—not only to recover from the severe damage to which it had been subjected, but to grow and develop into the present metropolis served by a vast network of 4,141 miles of water mains and more than 46,160 fire hydrants.

The Water Distribution Division plans, programs, designs, installs, operates and maintains the water mains, valves, hydrants and other distribution appurtenances of the Chicago Water System. During 1971, the water mains in service (varying in diameter from six to sixty inches) were extended by almost 19 miles but the net increase for the year was somewhat less because some mains were abandoned. Mains are removed from service if conditions in the area in which they are located have changed enough

to render their use unnecessary; or if they have deteriorated to a point where maintenance costs are too high.

Major 1971 water pipe installation projects included over 54,000 feet of 12-inch main; approximately 21,000 feet of 8-inch main; 13,000 feet of 16-inch main; 5,000 feet of 36-inch main; and over 4,750 feet of 60-inch main. Among the feeder mains placed in service were: 4,980 feet of 36-inch pipe on Lake Shore Drive, extending from Montrose Avenue to Addison Street; and 4,755 feet of 60-inch pipe on Milwaukee Avenue, from Wilson Avenue to Leland Avenue. Also, 301 fire hydrants and 265 valves were installed.

During the year, the Division's repair crews performed 1,207 maintenance and repair jobs. Maintenance trucks are equipped with radios so that work crews can be swiftly dispatched at any hour when emergency repairs are imperative. Surveys are conducted by leak specialists and service complaints are investigated by inspectors.

An electro-sonic method to locate water leaks has been followed almost exclusively since 1963. The equipment and techniques involved were developed by engineers of the Water Leak Control Unit, and during the period 1963-1971, 20,400 miles of mains were tested. In 1971, more than 3,000 miles of mains were surveyed for water leaks.

During the year, a total of 10,497 feet of cast



Nearly 19 miles of large, pre-stressed concrete water mains were constructed during 1971.

iron feeder mains were cleaned and cement-lined in a continuing program which restores the interior of the main and its capacity practically to its original state. Also, the experimental procedure for the cleaning of water mains was continued. In this method of pipe cleaning, plastic coated foam swabs (known as Polly-pigs) are inserted into the mains and the pigs are forced through the pipe by water pressure so that sediment and tubercles are scraped from the pipe wall. A total of 8,438 feet of 8-inch and 12-inch water mains were cleaned in 1971 by this method and placed back into service on the same day of cleaning. Periodic hydraulic testing of these mains validates the effectiveness of this method of cleaning.

The Plumbing Inspection Section is constantly vigilant for water supply hazards stemming from infractions of Chapters 82 and 83 of the Municipal Code of Chicago and other pertinent laws and regulations governing plumbing in-

stallations. Plumbing Inspectors' activities during 1971 included 2,458 first inspections; 4,074 reinspections; 4,189 wrecked building inspections; 14,625 building permit and service pipe inspections; 2,898 meter inspections; and 7,461 water contamination prevention inspections. In addition, 5,024 inspections were made for the Department of Buildings and 4,628 plan examination inspections, 34,040 special leakage and wastage survey inspections, 2,766 service pipe installation inspections, 3,071 special investigations and 22,503 initial inspections and 146,517 reinspections on fixtures and connections were conducted.

The Plumbing Testing Laboratory tested a total of 253 various water-connected appliances to insure their conformity with City ordinances and make certain that they will not introduce any hazards when placed into use in the Chicago water supply system.



Main under construction at Lawrence and Oketo Avenues will connect the Mayfair Pumping Station to O'Hare Airport.



METERING

At the close of 1971, the number of meters in service totaled 163,988, of which 889 were installed during the year. The activities of the Water Meter Division entail both field and shop work. In 1971, 16,344 meters were inspected in the shop and, of these, 15,144 were completely reconditioned and tested for accuracy. In addition, 12,497 meters were repaired in the field at the site of installation.

The Water Meter Division is likewise responsible for the installation and maintenance of the large turbine-type meters that measure the quantity of water that is supplied to suburban communities by the Chicago Water System.

The experimental program aimed at finding a remote water meter reader that registers accurately and can be installed satisfactorily by Meter Division forces continued during the year.

So far, some 20 remote readers, manufactured by different companies, have been installed on the outside of building structures. If results of this experiment are favorable, the reading of meters would be expedited and the Bureau of Water would be relieved of the basement-key-custody and basement-entry problems. The worthwhileness of such an improvement is evident when considered together with the fact that the quantity of water supplied by the Chicago Water System and sold through meters has been steadily increasing. Currently, nearly 80 per cent of Chicago's water revenues comes from the sale of metered water.

In 1971, a water meter modernization program began. Kits have been purchased to convert gear-driven meters into sealed-register magnetic driven meters. This will reduce repair costs and facilitate remote meter reading.

When 1971 ended, the total number of accounts serviced by the Water Collection Division stood at 510,839. Water Fund collections for the year amounting to \$71,004,306 included \$56,581,575 from meter-rate accounts; \$14,342,503 from assessed-rate accounts; \$66,699 from sewer rental accounts for properties located outside the corporate limits of Chicago; and \$13,529 from miscellaneous sources.

During the year, the water rate takers made 1,210,775 meter readings, 50,769 visits to prop-

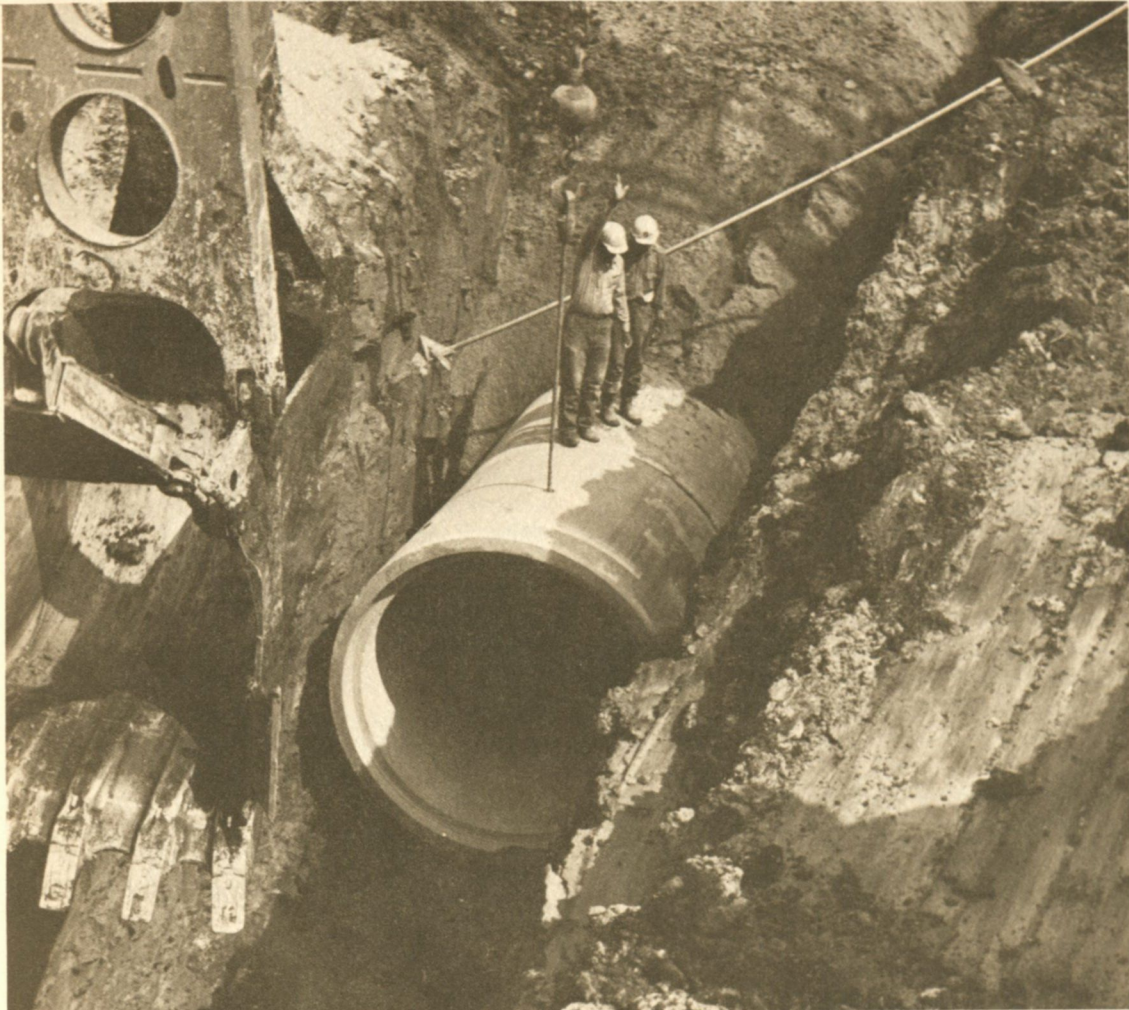
erties to make assessments and resolve problems regarding water bills and 41,411 calls to collect \$898,026 on delinquent water charges.

In 1971, the conversion of billing and accounting procedures was accelerated. With the installation of new computer systems and equipment, complete information concerning each customer's account, or group of accounts, can be recalled from data cell storage to a screen for observation or to a print-out for analysis.

ASSESSING BILLING AND COLLECTING



New Computer systems and equipment in operation.



15

Constructing large sewer—Chicago has more than 4100 miles of sewers, some as large as 21 feet in diameter.



Left—rebuilding brick sewer arch. Center—repaired brick sewer. Right—engineers test effluent pH value.

approach and is being built by an underground mining process, as opposed to the more conventional open cut or trenching method which often interferes with surface traffic. The laser beam-guided rock mining machine used in the building of the tunnel is 13½ feet in diameter and has a giant rotating drill with rock cutters on the face that is forced against the rock with tremendous pressure. What is cut away is collected and removed by a conveyor.

When the Lawrence Avenue underflow tunnel is completed, sanitary drainage will continue to be collected by the sewers presently in service during normal periods and discharged into the interceptors of the Sanitary District. During periods of heavy flow resulting from storm runoff when the capacity of the regular sewers is exceeded, the excess runoff will be diverted by drop shafts into the new deep-level sewer rather than overflow into the Chicago waterways. Large quantities of storm water and sanitary drainage will be stored in the underground facility until the waste treatment plants of the Metropolitan Sanitary District of Greater Chicago are again able to cope with the additional storm and sanitary flow.

The tunnel runs five miles westward under Lawrence Avenue, some 250 feet below the surface, from the North Branch of the Chicago River near California Avenue to Melvina Street (6200 West).

The Lawrence Avenue Tunnel will be an element in a network of such facilities designed to eliminate the problems associated with combined sewer overflows.

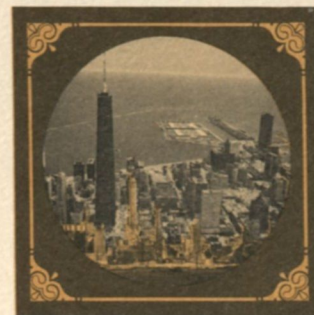
Two other underflow systems have been placed under contract by the Metropolitan Sanitary District of Greater Chicago—one along 47th Street in LaGrange and the other under Crawford Avenue north of the Calumet Sag Channel.

Field tests of various types of modern sewer cleaning machines were conducted by personnel of the Engineering and Cleaning Divisions of the Bureau of Sewers, after which the Department purchased a multiple-use vacuum vehicle which is anticipated to substantially reduce sewer cleaning costs. The amount of work that can be accomplished will increase without the need of a corresponding increase in manpower. The new machine first jet-roads and flushes the sewer line with a high pressure hose, then vacuums up the debris from the manholes. Catch basins can also be rapidly cleaned by this unit.

During the year, an electronic pipe locator was also purchased to be used in detecting the position and determining the depth of non-metallic sewer pipe. Signals generated by a radio transmitter taped to a sewer rod inserted in the line are picked up by a receiver on the surface which enables the operator to plot the location and alignment of the pipe.



Left—Sewer scraping machine in operation, Right—New equipment used to jet-rod sewers and remove debris.



SAFETY

Not only do work-connected accidents boost operating costs; they cause pain, grief and the loss of unrecoverable time. With awareness of the fact that such mishaps can be prevented, Chicago was one of the first large cities in the Country to develop and put into effect in its water and sewer operations a formal safety program designed to reduce employee injuries. The program's purpose is also to protect the public from accidents that might result from the field and plant facility work in which the Department of Water and Sewers is engaged.

During 1971, the Department's accident frequency rate stood at 11.12—less than half the national average rate of 23.13 for water utilities, as compiled by the National Safety Council from the latest figures available. The Department's severity rate of 358 for 1971 (a substantial improvement over the preceding year) was only a little over one third the national average rate of 965.

In 1971, all employees were provided with pocket-size safety handbooks. The Safety booklet contains rules and regulations governing the work done by employees in the various activities of the Department. It is also supplemented by Division Safety Manuals which outline safety procedures specifically applicable to personnel

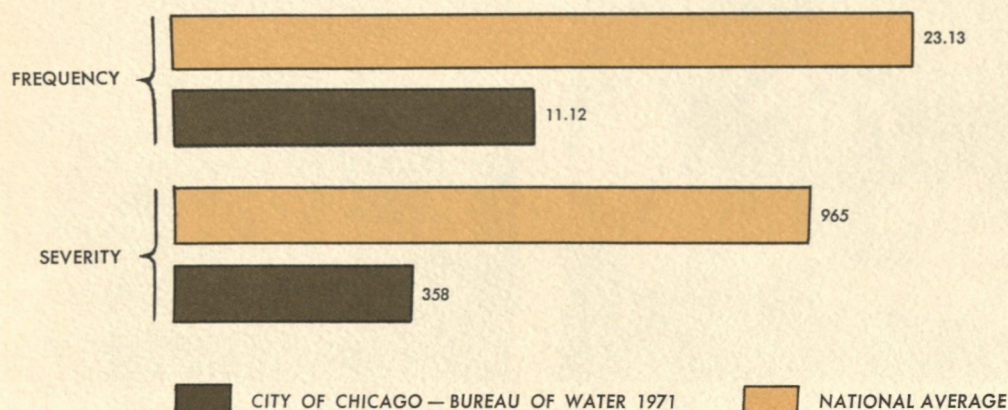
working in the respective division activities of the Department.

Line supervisors are assisted by safety committees and safety representatives of the several operating units in developing and carrying out the prescribed rules for safe work practices. All accidents are accurately reported and properly recorded. Rules regarding the use of appropriate safety equipment are rigidly enforced. The general respect for the effectiveness of the safety measures by which the Department attained its excellent safety record is indicated to some extent by the frequent requests for copies of its Safety Manuals and its Annual Accident Data Report.

The Department of Water and Sewers, the Bureau of Water, the Bureau of Sewers and the Administrative Staff of the Commissioner of the Department were, as separate entities, presented Awards of Merit for 1971 by the National Safety Council. These honors, which were conferred in recognition of good safety records, are based on unit accident rates for the three preceding years. Also, the National Safety Council awarded the Commissioner's Staff a Certificate of Commendation for having operated without disabling injuries to employees during 486,053 man-hours, from July 14, 1958 to the end of 1971.

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AVERAGE ACCIDENT RATES FOR WATER UTILITIES



IN-SERVICE TRAINING

The staff of the Department of Water and Sewers is firm in its conviction that an adequate training program is essential to the effective operation of a public utility. Time and efforts invested in the education of an organization's work force for the purpose of enhancing its efficiency are wisely expended.

In 1971, while the Department continued those intensive training programs already on its agenda, it also formed new plans to expand in other areas during the coming year with the aim of providing equal opportunities for employees to develop their potentialities.

At the close of the year covered by this Report, a special training program directed toward a limited number of employees holding first-line and middle management positions was in the developmental stage. This program will provide for the presentation of basic management techniques and the clarification of responsibilities to those persons accountable, at various levels, for the operations and for the conduct of the affairs of the Department.

A program of specialized instruction is also pursued by the Water Purification Division for the purpose of increasing the competency of technical personnel in the discharge of their job assignments. Two training sessions are held each month during a 10-month period for approximately 120 employees, including engineers, chemists, bacteriologists and biologists. Sixty employees of the Bureau of Sewers attended an in-service training program concerned with sewer construction and maintenance methods and techniques. Sessions were held at the Central Water Filtration Plant during January and February of 1971, one half day

each week for eight weeks. Instructions were given by personnel of the Bureau and also guest speakers were provided by the Bureau of Water; all were specialists in their respective areas of discussion.

In 1971, the Department initiated an experimental job-rotation program for newly employed engineers. Under this plan, participants will be acquainted with various departmental activities so that, ultimately, they can be assigned to positions where they will be most effective. Also, under a program emphasizing the combination of training with experience, a number of high school and college students were employed on a part-time basis.

In addition, a wide range of training activities through outside agencies are available to employees of this Department. For instance, the Chicago Civil Service Commission will reimburse persons for tuition expenses incurred while attending classes in accredited colleges or universities on subjects related to their work, or required for degrees in fields related to their work. During 1971, approximately 60 courses were completed by departmental personnel. The Civil Service Commission also provided a number of classes for employees who wished to improve their typing or stenographic skills. They were presented on a shared-time basis, usually beginning late in the afternoon so that students could attend partly on City-time and partly on their own time.

Also during the year, several employees enrolled in brief seminars sponsored by such organizations as the Chicago Civil Service Commission, the American Water Works Association and the American Public Works Association.

18



Bureau of Sewers engineers instruct field inspectors in use of engineering records.



Specialized instruction program is conducted by Water Purification Division.



FINANCIAL REPORTS

The Chicago Water System is supported entirely through revenues received from the sale of water. The System receives no funds from real estate or other tax levies. Accordingly, as a municipally owned and operated utility, the water rates are designed to cover operating, maintenance, and debt service costs. The Chicago Water System is not operated for profit. The preliminary statements submitted with this report were prepared on a utility (accrual) basis. The final and official statements submitted by the City Comptroller in his report for 1971, will reflect any adjusting entries arising from audit and accordingly, may differ slightly from these earlier and preliminary statements.

During 1971 total cash revenues from sales of water increased to \$70.9 million from the \$68.4 million received in 1970. A change in billing schedules and reporting, to provide a more uniform work load and better maintenance controls, reflects operating rev-

enues received on a utility basis during 1971 as \$69,344,859. Operating and maintenance expenses before the provision for depreciation of \$8,429,109 totaled \$56,528,637. Debt service costs of \$15,094,422 included the interest and principal payments on Certificates of Indebtedness.

The total investment in Capital Assets rose from \$535.6 million dollars to \$546.9 million dollars during the year. While the net book value of the Water Funds Capital Assets are carried at 430.4 million dollars, the estimated actual replacement, valued conservatively would exceed a billion dollars.

The Preliminary Combined Balance Sheet and Preliminary Combined Statement of Operations and Equity, presented on the following pages, were prepared on a utility basis, while the Statement of Cash Flow presented on this page was prepared on an actual cash receipts and disbursement basis.

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CITY OF CHICAGO—WATER WORKS FUNDS STATEMENT OF CASH FLOW For the Year Ended December 31, 1971

	Detail	Amount	%
CASH BALANCE, JANUARY 1, 1971		\$ 27,047,450	
CASH RECEIVED FROM:			
Sale of Water:			
Loop and Large Commercial Consumers	\$16,601,034		23.41
Large Industrial Consumers	11,610,539		16.37
Smaller Metered Consumers	11,056,040		15.59
Suburbs and Consumers in Unincorporated Areas	17,313,962		24.41
Total from Metered Sales	\$56,581,575		79.78
Single and Double Unit Residential Dwellings	14,342,503		20.22
Total Cash from Sales of Water	\$70,924,078		100.00
Permits, Rentals, Reimbursements, Financial Income, Sale of Salvage, and various other Cash Received	1,234,808		
Services Provided Other Funds	150,225		
Sale of Water Certificates	\$25,002,084		
Proceeds Deposited January, 1972	10,500,000		
Proceeds Deposited December, 1971	14,502,084		
Total Cash Received During Year		86,811,195	
Total Cash Available During 1971		\$113,858,645	
CASH USED FOR:			
Source of Supply	\$ 431,517		.50
Power and Pumping	9,630,679		11.25
Purification	10,354,090		12.08
Transmission and Distribution	17,435,627		20.35
Drainage, Maintenance and Operation	11,813,690		13.78
Consumer Accounting and Collection	3,515,918		4.10
Administration and General	6,403,600		7.48
Total Operating Expenses	\$59,585,121		69.54
Debt Service			
Retirement of Long Term Debt	\$ 8,100,000		9.45
Interest Paid	7,065,000		8.24
Total Debt Service	15,165,000		17.69
Payments to Other Funds	302,108		.35
Payment of Water Pipe Extension Certificates	201,671		.24
Capital Improvements	10,440,816		12.18
Total Cash Disbursements During Year		85,694,716	100.00
CASH BALANCE, DECEMBER 31, 1971		\$ 28,163,929	



CITY OF CHICAGO WATER WORKS FUNDS

*PRELIMINARY COMBINED BALANCE SHEET—UTILITY BASIS At December 31, 1971

ASSETS

Utility Plant:			
Structures, Improvements and Equipment	\$538,927,290		
Less: Accumulated Depreciation	<u>116,579,186</u>		
Net: Structures, Improvements and Equipment	\$422,348,104		
Land and Land Rights	1,949,150		
Construction Work in Progress	<u>6,059,063</u>		
NET UTILITY PLANT			\$430,356,317
Investment in Working Capital Funds**			<u>6,572,716</u>
Current Assets:			
Cash Deposited and on Hand	\$ 28,163,929		
Accounts Receivable	6,229,949		
Due from Other City Funds	10,510,440		
Inventories	<u>2,062,781</u>		
TOTAL CURRENT ASSETS			<u>46,967,099</u>
TOTAL ASSETS			<u>\$483,896,132</u>

LIABILITIES AND CITY EQUITY

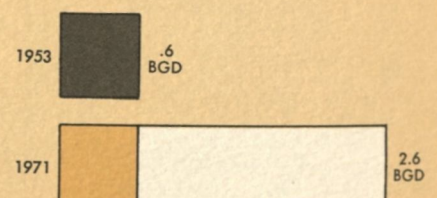
City of Chicago Equity			
Long Term Liabilities:			
Certificates of Indebtedness	\$192,400,000		\$282,048,930
Water Pipe Extension Certificates	499,895		
Contracts Payable for Water Main Installations	<u>208,196</u>		
TOTAL LONG TERM LIABILITIES			<u>193,108,091</u>
Current Liabilities:			
Vouchers Payable	\$ 7,104,062		
Interest Payable	1,575,204		
Due to Other City Funds	147		
Refunds and Judgments Payable	<u>59,698</u>		
TOTAL CURRENT LIABILITIES			<u>8,739,111</u>
TOTAL LIABILITIES AND CITY EQUITY			<u>\$483,896,132</u>

CHICAGO WATER SYSTEM INSTALLED CAPACITIES COMPARISON 1953* - 1971

(In Billions of Gallons Per Day)

*THE DEPARTMENT OF WATER AND SEWERS WAS ESTABLISHED
AS A SEPARATE ENTITY IN 1953

FILTRATION



***PRELIMINARY STATEMENT OF OPERATIONS
AND EQUITY—UTILITY BASIS**

For the Year Ended December 31, 1971

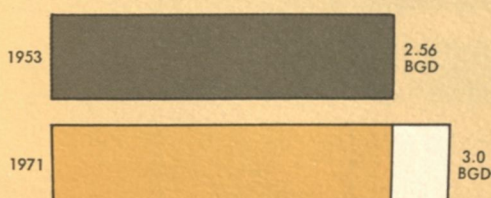
Operating Revenues:		
Sales of Water		\$ 68,725,365
Other Operating Revenue		<u>619,494</u>
TOTAL OPERATING REVENUES		\$ 69,344,859
Operating Expenses, Excluding Depreciation:		
Source of Supply	\$ 478,071	
Power and Pumping	8,699,020	
Purification	10,080,349	
Transmission and Distribution	17,118,921	
Drainage, Maintenance and Operation	10,868,258	
Consumer Accounting and Collection	3,144,383	
Administration and General	<u>6,139,635</u>	
TOTAL OPERATING EXPENSES EXCLUDING DEPRECIATION		<u>56,528,637</u>
Operating Income Before Depreciation		\$ 12,816,222
Depreciation Expense		<u>8,429,109</u>
Operating Income		\$ 4,387,113
Add Non-Operating Income		582,407
Deduct Non-Operating Expense		
Net Interest on Water Certificates	\$ 6,800,767	
Other Non-Operating Expenses	<u>108,461</u>	<u>6,909,228</u>
Balance after Non-Operating Transactions		\$ (1,939,708)
Operations of Working Capital Funds**		<u>(360,856)</u>
Expenses in Excess of Income		<u>\$ (2,300,564)</u>
CITY EQUITY, JANUARY 1, 1971	\$284,363,707	
Less Surplus Adjustments	<u>14,213</u>	<u>284,349,494</u>
CITY EQUITY, DECEMBER 31, 1971		<u>\$282,048,930</u>

**Includes estimated loss of \$600,000 for Public Works Construction Capital Account.

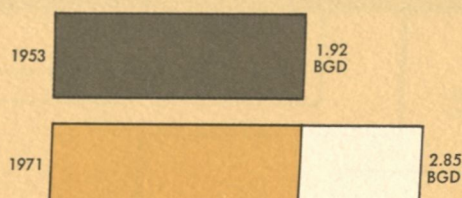
*These statements represent a preliminary financial summary of the Water Funds and are not final. Final statements will be included in the City Comptroller's Report for 1971.

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PUMPING



TUNNELS





CAPITAL IMPROVEMENTS PROGRAM

22

During 1971, nearly ten and a half million dollars were invested in the Chicago Water System in keeping with the ongoing program of new and expanded services in the System's plants and facilities. Included in the \$6,804,364 expended for water mains and appurtenances is a thirty-six inch main being constructed to better serve the North Shore area and the increasing demand of high rise apartments. Another major operation is the second phase of a project for a major 60-inch feeder main, approximately eight miles in length at completion for improvement of service to the Northwest area, including suburban communities. \$1,279,180 was invested in improving the System's pumping stations, with one of the primary objectives the continued conversion of boiler equipment in the steam operated stations from coal to natural gas, in keeping with Chicago's drive for cleaner air.

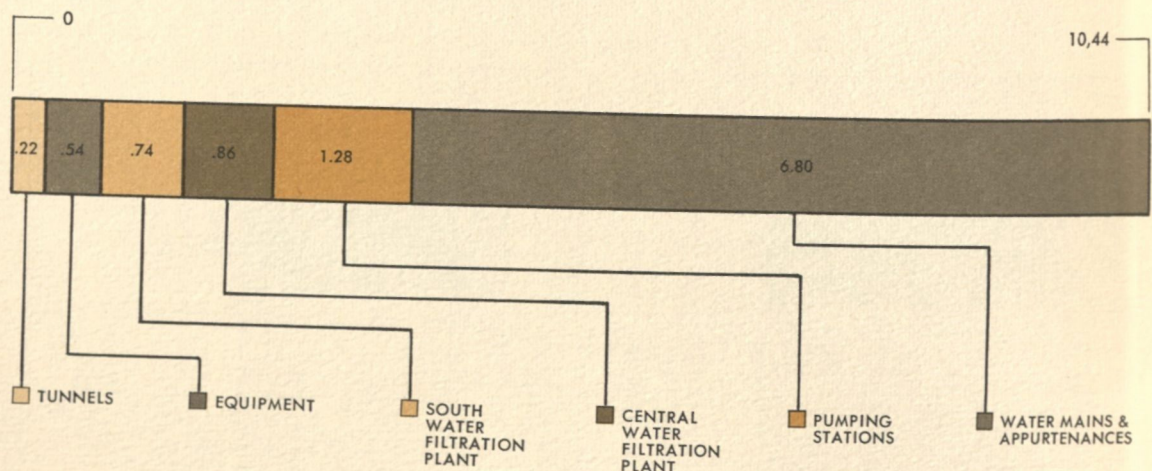
Improvements at the filtration plants included an addition to the chemical building at the South Filtration Plant for the housing of a new control center which will include laboratory facilities.

The Central Filtration Plant improvements included replacement of glass chlorine lines to intake basins, outlet shafts and reservoirs. New equipment accounted for \$536,345.

The five-year Capital Improvement Program for the Chicago Water System was planned in co-operation with the Departments of Public Works and Development and Planning and covers the years 1971 to 1975. The program, subject to annual revisions and approval by the City Council, provides for new investments in the Water System of \$155,828,000; to include \$35,175,000 for tunnels and reservoirs, \$24,685,000 for the filtration plants, \$16,533,000 for the pumping stations, and \$74,435,000 for water main construction. An expenditure of \$113,464,000 is projected for additions to the City's Sewer System including storm water control elements. This program is planned and administered by the Department of Public Works with the Department of Water and Sewers assuming responsibility for maintenance and operation of these facilities after completion.

CAPITAL IMPROVEMENTS 1971—IN MILLIONS OF DOLLARS

(TOTAL \$10,440,816) CASH FLOW BASIS



BUREAU OF WATER

Filtration Plants	\$ 24,685,000
Pumping Stations	16,533,000
Water Tunnels and Reservoirs	35,175,000
Feeder Mains 24" Dia. and Larger	13,926,000
Small Mains	60,509,000
Cleaning and Lining of Feeder Mains	5,000,000
Total Program	<u>\$155,828,000</u>

CAPITAL IMPROVEMENTS PROGRAM 1971-1975

BUREAU OF SEWERS*

Capital Improvements Program 1971-1975	\$103,965,000
Storm Water Control (O'Hare Airport)	9,500,000
Total Program	<u>\$113,465,000</u>
Total Water and Sewers	<u>\$269,293,000</u>

*Programmed under the direction of the Department of Public Works.

BUREAU OF WATER

Filtration Plants	\$132,953,416
Pumping Stations	26,115,784
Water Tunnels & Cribbs	8,277,468
Water Mains & Distribution System	134,475,209
Equipment	6,244,107
Total Investment	<u>\$308,065,984</u>

INVESTMENT IN CAPITAL IMPROVEMENTS 1953-1971

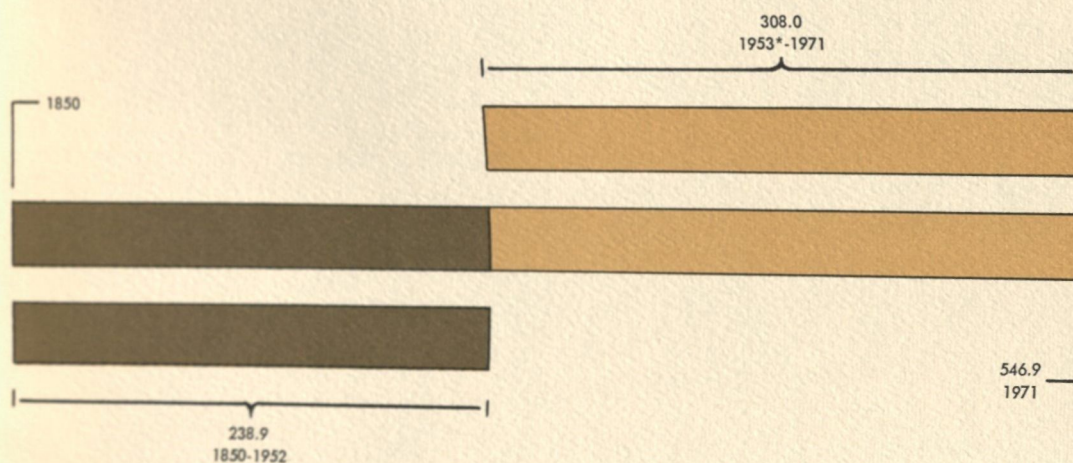
BUREAU OF SEWERS*

Investment in Capital Improvements	\$173,190,778
Total Water and Sewers	<u>\$481,256,762</u>

*Constructed by the Department of Public Works, Illinois Division of Highways and Cook County Highway Department with maintenance and operation the responsibility of the Department of Water and Sewers.

INVESTMENT IN FIXED ASSETS—IN MILLIONS OF DOLLARS

1850-1971



REPLACEMENT VALUE TODAY — WELL OVER A BILLION DOLLARS

*THE DEPARTMENT OF WATER AND SEWERS WAS ESTABLISHED AS A SEPARATE ENTITY JANUARY 1, 1953



MAJOR STATISTICS FOR 1971

SEWERS

Existing Sewer System

Miles of Sewer	4132.06
Catch Basins	213,671
Manholes	148,020

1971 New Sewer Construction

Miles of Sewers—all sizes	26.26
Catch Basins	850
Manholes	897

24 **Inspections** 156,698

Complaints Handled 54,199

Repairs

Total Number of Sewer System Repair Jobs	11,706
Main Sewer Breaks	464
Catch Basins	8,007
Manholes	1,645
Gutter Grates and Basin Outlets	1,590

Cleaning

Sewers Scraped—Feet	10,648,148
Catch Basins Cleaned	307,085

Street Grades Established and Approved by City Council

65

Standard Bench Monuments and Ordinary Benches Established

185

Receipts

House Drain Permit Fees	\$ 80,405
Other Permit Fees	67,934
Special Deposits	135,348
Out-of-Town Connection Fees	66,699
Drain Layers' License Fees	36,525
Total Receipts	\$ 386,911

WATER

Population and Area Served

(Based on Reliable Estimates)

Population supplied:

Chicago (1970 U.S. Census 3,366,957) ..	3,367,000
Suburban (Year-end census as revised) ..	1,155,000
Total	4,522,000

Area served (in square miles):

Chicago	227
Seventy-two suburbs	213
Total	440

Per Capita Consumption

	Gallons Per Day
Chicago	255
Suburban	146
Average	227

Chemical and Physical Qualities of Water at Intake (Central Water Filtration Plant)

Total hardness (as parts per million)	
Calcium Carbonate	130
Water temperatures: Intake	
Average	48
Maximum	69
Minimum	32

Pumpage

Annual	Gallons
Chicago	313,503,300,000
Suburban communities and industries (metered)	61,744,160,000
Total*	375,247,460,000

*(Amount through
Western Ave. Reservoir) 1,621,000,000

Annual Metered Consumption in Chicago
(52.0%† of Chicago pumpage) 163,106,500,000

†Percentage of Revenue
from Metered rates: 79.8%

Daily	
Total daily average	1,028,080,000
Maximum day, June 29	1,762,650,000
Maximum hour (rate) June 29, 4:00 P.M.	2,305,000,000
Daily Average — Chicago	858,910,000
Daily Average — Suburban	169,170,000

WATER

Purity Control

Laboratory tests made:	
Microbiology Laboratory	228,121
Microscopy Laboratory	16,822
Chemical Laboratory	133,136
Control Laboratory S.W.F.P.	145,726
Control Laboratory C.W.F.P.	265,000
Total tests made	788,805

Bacteriological Results

Annual average coliform organisms per 100 ml*

	South District		North & Central District	
	Crib	Shore	Crib	Shore
Raw (MPN)	27.0	13.0	25	38
Plant Outlet (MF)*	0.007		0.010	
Pumping Stations (MF)* ...	0.016		0.000	
on Distribution				
Systems (MF)*	0.097		0.023	

*U.S. Public Health Service Standards for safe drinking water by the membrane filter (MF) technique specifies that the arithmetic mean of all standard samples examined each month shall not exceed 1.0 coliform organisms per 100 ml.

Purification Treatment

	Gallons
Complete Filtration Treatment	394,795,000,000

Chemicals Applied — Tons

	SWFP	CWFP
Chlorine	1172	1947
Aluminum Sulfate (17% Al_2O_3)	4717	6942
Activated Carbon	391	200
Lime (as CaO)	1795	2716
Ferrous Sulfate (as $FeSO_4$)	722	2495
Anhydrous Ammonia	171	209
Hydrofluosilicic Acid (as Fluorine)	579	921
Caustic Soda (NaOH)	—	1562

Supply

Crib intakes in service	3
Crib intakes on stand-by service	1
Shore intakes	2
Miles of water supply tunnels under lake and land (6 to 20 feet in diameter)	72.6

Pumping

Pumping stations	11
Pumps available for service	53
Installed pumping capacity (Million gallons per day)	2,995

Annual Pumpage

	Million Gallons
By electrically driven pumps	159,683
By steam driven pumps	215,564
Total annual pumpage ..	375,247
Coal used by steam powered pumps (tons)	79,651
Electric power used by electrically powered pumps (kilowatt hrs.)	86,053,672
Oil (Gallons)	480,996
Gas (Therms)	12,665,283.13

Distribution

Water Mains: (in miles)

In use — December 31, 1971	4140.99
Extended	18.77
Abandoned	12.51
Net addition to system	6.26
Diameter of pipe (inches)	6 to 60

Fire Hydrants:

In use — December 31, 1971	46,164
Installed	301
Abandoned	161
Net Increase	140

Valves:

In use — December 31, 1971	43,180
Installed	265
Abandoned	173
Net Increase	92

Pressure range in mains

(lbs. per square inch)	28 to 58
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Average pressure at curb

(lbs. per square inch)	36
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Miles of pipe tested for underground leakage. 3000.42

Premises inspected — house to house leakage survey

Repaired main breaks — 4 inch to 48 inch in diameter	359
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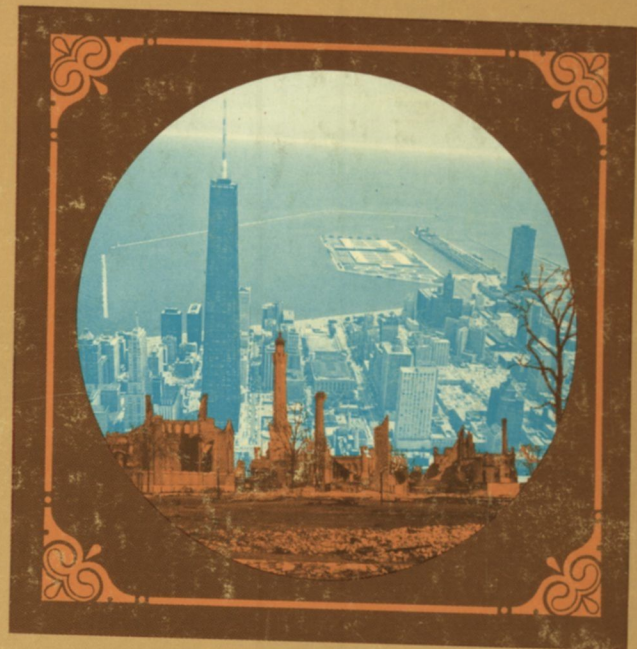
Meters

In service — December 31, 1971	163,988
Installed by Master Plumbers	824
Installed by Water Distribution Division	65
Total	889
Removed	1,785
Net Decrease	896
Repaired on premises	12,497
Repaired in shops	15,144
Tested	16,344
Non-metered (assessed rate) services	346,851
Total Services (assessed and metered)	510,839

Supplements covering complete 1971 water or sewer statistics are available upon request.

ANNUAL
1971
REPORT

DEPARTMENT OF WATER AND SEWERS • CITY OF CHICAGO



A CENTURY OF RECOVERY AND GROWTH

